Machine Learning

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Key elements in machine learning

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- Depending on the nature of the function (related to the presence or not of labels) we are doing **supervised** or **unsupervised** learning.
- The learning consists of the optimization of the parameters.
- There are several keywords in the learning process.
  - Learning (or optimization) **criterion**.
  - **complexity**.
- It is worth to talk about linear or **nonlinear** behavior.

Structure and learning criterion

- In a learning process, the practitioner has to choose a structure and then a training criterion.
- The structure is explicit in the estimation function. For example, one can choose to use a family of linear functions

$$\hat{y}_i = \mathbf{w}^\top \mathbf{x} + b$$

- A criterion needs then to be chosen to optimize parameters $\mathbf{w}$.
  - The simplest one in supervised learning is the minimization of the mean square error.

$$e^2 = (y_i - \hat{y}_i)^2$$

  - Other criteria are suitable ($L_1, L_3 ...$). Maximum Margin Methods are very popular nowadays. Maximum likelihood approaches are also widely used.

The Occam Razor:

Entities should be not multiplied without necessity.

XIV century philosopher and Franciscan friar William Occam wrote it in Latin:

Pluralitas non est ponenda sine necessitate

This is, in plain English, the KISS principle:

Keep It Simply Smooth.

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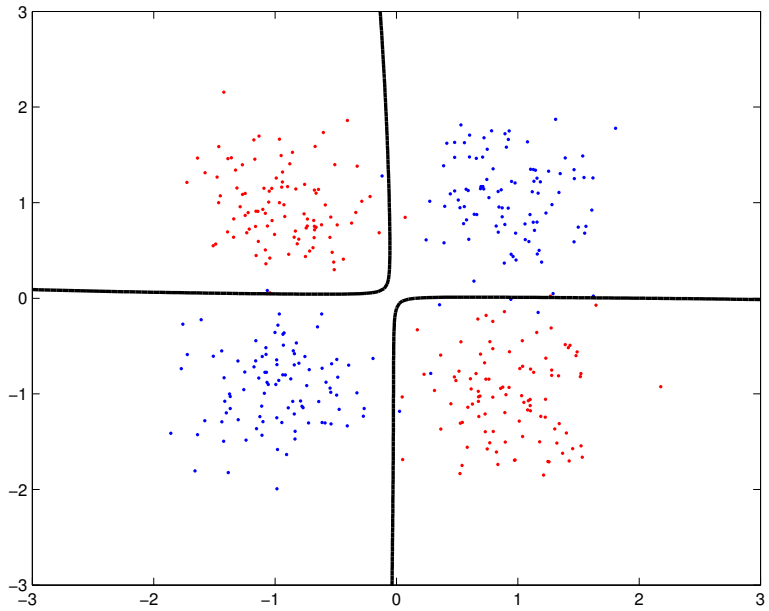
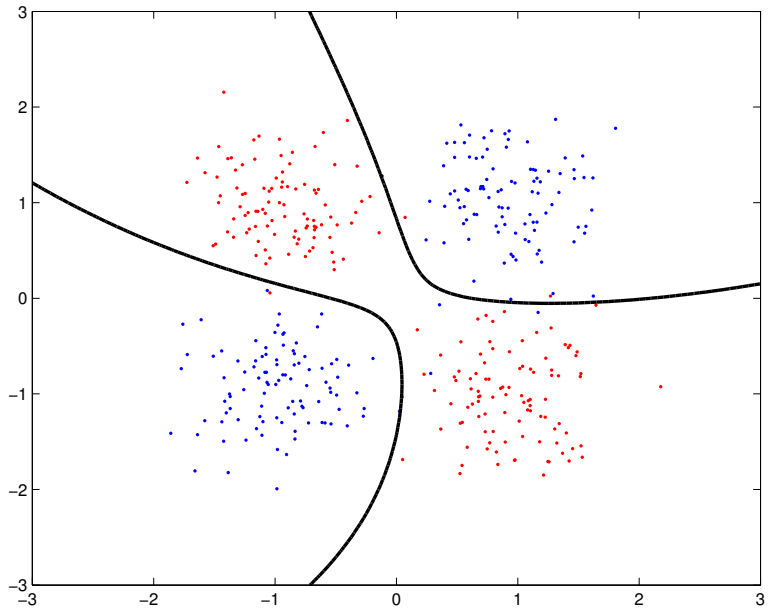
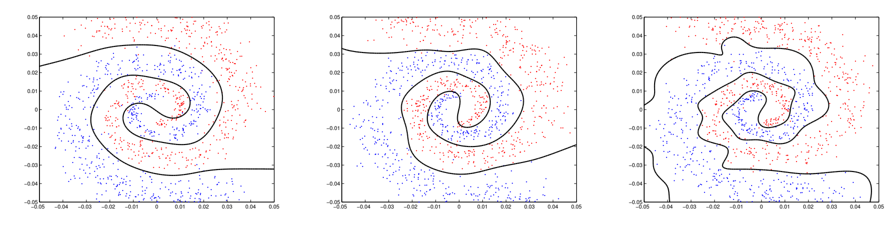
Complexity





Complexity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Lesson outcomes

Main concepts to remember:

- Supervised and unsupervised learning.
- Learning criteria.
- Complexity: the Occam Razor.